

Stream is only a modified and partial cause of this general circulation. Now in the first place, as I have already said, it seems to me that the distribution of warm water in the North Atlantic has been traced to its source, and all the general phenomena of the Gulf Stream, its origin, its course, its extension, and its depth at certain points, have been *proved* by the careful observations of many years, which I see no reason whatever to doubt. The constant impulse of the trade wind drives a broad current of equatorial water against the American coast. A great part of this current is observed to turn northwards through the Strait and round the islands, and to pour an eternal flood of hot water in a certain direction, under known laws, into the closed basin of the North Atlantic, and as a natural consequence the temperature is very considerably raised.

We are undoubtedly most deeply indebted to Dr. Carpenter for the forcible way in which he has brought forward the arguments on the other side; and, after carefully considering everything, I am thoroughly willing, with Sir John Herschel, to cede that "there is no refusing to admit that an oceanic circulation of some sort must arise from mere heat, cold, and evaporation as *vera causa*;" and that "henceforward the question of ocean currents will have to be studied under a twofold point of view;" but my strong conviction is that if the sagacious philosopher whose loss we now deplore, had been spared so to study it, he would have only been strengthened in his verdict of 1861 as to the Gulf Stream, that there can be no "possible ground for doubting that it owes its origin entirely to the trade-winds." Dr. Carpenter attributes the general oceanic circulation, of which he regards the Gulf Stream as only a modified case, to tropical heat and evaporation, and arctic cold, possibly aided by differences of barometric pressures; or to convection pure and simple, as illustrated in his experiments before the Royal Institution and the Geographical Society. Now what we expect of Dr. Carpenter before we are called upon to accept to the full his magnificent generalisation, is a calculation and demonstration of the amount of the effect of the causes upon which he depends acting under the special circumstances. We must remember that heat is received by the ocean at the surface only, and that owing to cold draughts all over the globe, so far as we know the temperature falls the deeper we go; that all our observations tend to show that the temperature of the sea is only influenced by direct solar radiation to any amount to the depth of fifty fathoms, so that all currents depending upon difference between equatorial and polar temperatures must be produced and propagated in a film of water about the depth of the height of St. Paul's and 6,000 miles long. The black line bounding that chart represents pretty nearly the depth of the ocean, and even where the whole of the water supposed to be involved in the movement, it would be difficult to imagine a perceptible current to be produced in so thin and wide a sheet by such feeble cause. It would be impossible to indicate by the finest hair line the tenuity of the film which is actually affected by the direct rays of the sun. How differences in barometric pressure can produce constant currents I do not see. Rapid fluctuations in pressure in places within a short distance of one another will doubtless produce readjustment by a wave motion; but constant differences of pressure will simply produce constant differences of level and no currents. Varying pressures at very distant points cannot possibly produce a constant current. I freely admit that I am quite incapable of undertaking the investigations which might lead to the estimation of the relative or actual importance of these causes of currents. I have several times put the question to specialists in such physical inquiries, but they have always said that it was a matter of the greatest difficulty, but that their impression was that the effects would be infinitesimal.

I fear then that, in opposition to the views of my distinguished colleague, I must repeat that I have seen as yet no reason to modify the opinion which I have consistently held, that the remarkable conditions of climate on the coasts of Northern Europe are due in a broad sense solely to the Gulf Stream; that is to say, that while it would be madness to deny that in a great body of water at different temperatures, under varying barometric pressures, and subject to the surface drift of variable winds, currents of all kinds variable and more or less permanent must be set up, yet the influence of the great current which we call the Gulf Stream, the reflux in fact of the great equatorial current, is so paramount as to reduce all other causes to utter insignificance.

WYVILLE THOMSON

PHYSIOLOGY

The Mouse's Ear as an Organ of Sensation*

DR. SCHÖBL, of Prague, who lately published a remarkable paper on the wing of the bat, has made similar researches on the ear of the white mouse, with very interesting and surprising results (in "Schultze's Archiv," vol. vii. p. 260.) The first thing which struck Dr. Schöbl was the immense and "fabulous" richness of the ear in nerves. Even the bat's wing is but poorly supplied in comparison. The outer ear was carefully divided horizontally through the middle of the cartilage into two laminae, each of which was found to be equally supplied with nerves, and was then examined by removing the epidermis and the Malpighian layer of the skin. In each of these laminae were discovered three distinct strata of nerves, which are thus described: The first or lowest stratum lies immediately upon the cartilage; it consists of the largest trunks which enter the ear, 5 to 7 in number, and their next branches, varying from .074 mm. to .028 mm. in diameter. The mode of division of these trunks is mainly dichotomous, but they are connected by several different kinds of anastomoses; as, for instance, by decussation of two adjacent trunks, by transverse or oblique connecting branches, by plexuses, by loops, &c.; while branches also perforate the cartilage, and bring the nerves of the two halves of the ear into connection. The general distribution agrees with that of the larger blood-vessels. The second stratum lies immediately over the first, and is connected with it by a multitude of small branches, and by a fine marginal plexus at the outer border of the ear, which may be regarded as common to both. The diameter of its nerves is from .0185 mm. to .0098 mm.; it lies immediately under the capillary vascular network of the skin, and has a generally reticulated arrangement, forming plexuses of very various shapes. The third stratum of nerves, developed out of the very finest twigs of the second, lies at the level of the capillary network; it is composed of branches .0098 mm. to .0037 mm. in thickness, which (like those of the other strata) contain medullated nerve-fibres. It forms an extremely delicate network, like the second layer, but its finest branches may terminate in two ways. Some of them, each containing two to four medullated fibres, run directly to the hair follicles, and form a nervous ring round the shaft of the hair, terminating below the follicle in a nervous knot. Others, again, consisting of not more than two medullated fibres, bend towards the surface where the fibres lose their double outline, and form, immediately under the Malpighian layer of the skin, a fine terminal network of pale fibres, which is the fourth and ultimate stratum of nervous structures. The terminal "knots" or corpuscles, and the nervous rings, are inseparably connected with hairs and their sebaceous glands, so that through the whole of the external ear no hair can be found without this nervous apparatus, and *vice versa*. The connection of the hair follicle with the nerve termination is as follows:—Under the bulk of the hair in each follicle is a more or less conical prolongation, composed of distinct nucleated cells, which run vertically downwards, and is enclosed within the limiting membrane of the follicle. The nervous twig which, as has been said, runs to each hair follicle from the third stratum of nerves, makes several turns round the shaft of the hair, and from the ring thus formed two to four nerve-fibres run vertically downwards to the prolongation of the follicle, immediately beneath which they form a knot. These knots are almost always spherical, sometimes oval, and about .015 mm. in diameter. In each square millimetre of the marginal part of the ear there are about 90 such bodies, and near the base perhaps 20, so that the average number may be 30. Calculating from the average size of the ear of a common mouse, it is then found that there are on the average 3,000 nerve terminations on each of its surfaces, making 6,000 on each ear, or 12,000 altogether. The function of this elaborate arrangement would seem to be, like that in the wing of the bat, to supply by means of a very refined sense of touch, the want of vision to these subterranean animals.

SCIENTIFIC SERIALS

PART II. of the *Zeitschrift für Ethnologie* contains No. 6 of Dr. Hartmann's "Studies of the History of Domestic Animals," on the yak or grunting ox (*Bos grunniens*) living wild at immense altitudes in the mountains of Central Asia north of the Himalaya, and largely used in a domesticated state in Mongolia and

* From the "Quarterly Journal of Microscopical Science" for July.

Siberia. The cross between the yak and common ox has the advantage of thriving in a milder climate than that of the mountainous region of the yak. Dr. Hartmann also continues (No. 2) his summary of the available information as to "Lake Dwellings," here discussing their cultivation and preparation of grain and other vegetables. He reaffirms the usual conclusion that the cultivated plants of the lake dwellers of Central Europe indicate connection with the Mediterranean and even Africa. Perhaps the most remarkable point in the paper is the comparison of their large earthen jars for store corn, and their stone grain rubbers for meal, with similar jars and grain rubbers in modern Africa.—Prof. Meinicke's "Remarks on Wallace's Views as to the Population of the Indian Islands" are written in strong opposition to the English naturalist's theory as to the ethnological relations of Malays, Polynesians, and Papuans. With regard to Mr. Wallace's argument from contrast of the Malay character with the Papuan as proving difference of race, Prof. Meinicke argues that the Malay's courtesy and reserve may not be a race-character at all, but an effect of conversion to Mohammedanism; while revenge and bloodthirstiness belong to some Papuans as much as to Malays. In opposition to Mr. Wallace's view of Malays and Papuans being two distinct races, and of the Moluccas being largely populated by their intermixture, Prof. Meinicke claims the natives of the Moluccas as intermediate varieties forming a link of connection between the extreme Malay and Papuan types. As to the relation between Malays and Polynesians, Prof. Meinicke maintains the old and generally received view of an ethnological connection between them.—It is good evidence of the activity with which the science of man is now being pursued that Dr. W. Koner's useful bibliography of Anthropology, Ethnology, and Prehistoric Archaeology for 1863-70 extends to twenty pages of the journal.—Dr. Bastian's review of Darwin's "Descent of Man," expressing high admiration for its hypothetically-arranged evidence as a contribution to science, protests against the exaggeration of Darwinism, or rather, the return to Lamarckism prevalent among too impetuous followers of the development theory.

In the July number of the *Geological Magazine* (No. 85) the editor, Mr. Woodward, publishes a most interesting summary of the evidence extant as to the existence of limbs in the Trilobites, with a discussion of the significance of a remarkable specimen of *Asaphus*, lately described by Mr. Billings in the *Quarterly Journal of the Geological Society*. From a personal examination of the specimen, Prof. Dana was led to declare that the objects described by Mr. Billings as legs were merely calcified portions of the ventral integument destined to support branchial appendages. Mr. Woodward shows, and we think satisfactorily, that Prof. Dana is in error here. This valuable paper is illustrated with a plate contrasting the lower surface of Mr. Billings's Trilobite with that of the Norway lobster.—Mr. Hull contributes some observations on the general relations of the drift deposits of Ireland to those of Great Britain, in which the author confirms and extends the views adopted by Prof. Harkness as to the correlation of the Irish drift deposits with those of Britain, and the accordance of the whole with the principles laid down by Mr. Searles V. Wood, jun. A tabular statement of the phenomena of the three stages of the drift period in Britain concludes this paper.—From Mr. G. A. Lebour we have a note on the submergence of Is in western Brittany, in which, after referring to a Breton tradition that a town named Is was submerged in the Bay of Douarnenez some fifteen hundred years ago, he adduces certain evidence to show that a gradual depression is taking place along this coast. He notices a submerged forest in the small Bay de la Forêt.—Mr. Mackintosh continues his paper on the drifts of the west and south borders of the Lake district; Mr. A. G. Cameron describes the recently-discovered caverns at Stainton in Furness; and Mr. J. E. Taylor discusses the relation of the Red to the Norwich Crags.

THE first part of the fourteenth volume of the *Atti della Società Italiana di Scienze Naturali*, published in April of the present year, contains only three papers, more than one-third of its pages being occupied by the annual report, list of members, &c. The papers are a description of a new species of Dalmatian shell, by MM. A. and G. B. Villa, to which the authors give the name of *Clausilia de Cattania*; a long memoir on rennet and caseification, by M. C. Besana, and a short notice by Dr. C. Marinoni, of some new prehistoric remains collected in Lombardy.

SOCIETIES AND ACADEMIES

LONDON

Geologists' Association, July 7.—Prof. Morris, vice-president, in the chair. Mr. J. R. Pattison read a paper "On the Upper Limits of the Devonian System." The author did not wish to reopen the controversy which had taken place between the late Prof. Jukes and the supporters of the classification of the older geologists, but simply to lay before the Association a few facts as a prelude to a more complete paper which he hoped to bring forward during the next session. Mr. Pattison referred at some length to the fauna of the continental Devonian rocks, and strongly opposed the view recently put forward, that the Petherwin series is Lower Devonian and not Upper as generally supposed. He quite agreed with the older geologists in their classification, and concluded by recommending the sections exposed in North Devon to the attention of young geologists.—After some remarks by Prof. Tennant, Mr. Henry Woodward, and Mr. Loble, Prof. Morris described the distribution of the Devonian rocks throughout Europe, and remarked on the absence of vertebrate remains in the Devonian rocks of the South of England, in which corals and brachiopods abound, and the abundance of vertebrate remains in the Devonians or Old Red sandstones of Scotland, in which neither corals nor brachiopods have been detected. In the province of Oranburg, in Russia, however, the Devonian rocks contain both a vertebrate and a molluscan fauna.—A note "On a New Section of the Upper Bed of the London Clay," by Mr. Caleb Evans, drew the attention of the Association to an interesting exposure of a very fossiliferous bed of the London clay at Child's Hill, Hampstead. From an inconsiderable excavation at this place, Mr. Evans had collected in a short time twenty-three species, chiefly gasteropoda, in a fine state of preservation. This bed Mr. Evans considers to be the uppermost bed of the London clay, and immediately underlying the Bagshot sands, which form the summit of Hampstead Heath.

MAURITIUS

Meteorological Society, April 28.—The Honorable Colville Barclay, vice-president, in the chair.—The following letters and publications were laid upon the table:—1. A letter from Mr. James Duncan, Government Surveyor, forwarding a copy of observations taken at the Survey Camp, Vacoas, during the month of March last, at about 1,850 feet above the sea-level. 2. A letter from Mr. G. Jenner, Rodrigues, forwarding observations taken there in December, January, February, and March last. 3. From Mr. F. Timperley, Pamplemousses, giving a description of a meteor seen by him on the 22nd March. 4. Queensland Observations for October, November, and December 1870, by Mr. Edmund MacDonnell. 5. Singapore Observations for January 1871, by Dr. H. L. Randall.—"On the Converging of the Wind in Cyclones." The Secretary read the following letter addressed to him on the above subject by Captain Douglas Wales, Harbour Master:—"Some remarks of yours respecting the uncertainty of the real position of the centre of a cyclone set me thinking, and I send you a few ideas on the subject, which, as a sailor, I think worthy the serious attention of seamen, and the correctness of which they may put to the test of experience, whenever they have opportunities of doing so. Allow me to premise that I have no intention of dogmatizing. I believe our knowledge of the cause of these fearful tempests, of their origin, their progress in this or that direction, their rate of progression, their recurring, the reasons of those recurvings, and their ultimate dispersion, to be still in its infancy. No doubt, the knowledge already acquired has saved many a good ship from becoming entangled in these storms, especially ships approaching them on their equatorial sides; but at the same time it must be admitted that more than one intelligent seaman, who thought himself well up in the subject, has actually run into the very centre of a cyclone, when, by all known rules, he ought to have been certain of avoiding it. There must be some reason for such an error, and it is that reason that I have been seeking for, and which, I trust, I have to some extent discovered. I send you a diagram on a large scale, which will explain my views more clearly than any written description. I assume that within a diameter of 40, 50, 60, 70, or 80 miles, a true circular storm of terrific violence must be found in every so called hurricane, and that to a considerable distance outside and around this central and circular storm winds are to be found gradually decreasing in force from it, near the outer edge of the